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What drives postgraduate awarding gaps? Modelling master's degree outcomes

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ABSTRACT

There is a concern across higher education that educational outcomes vary across a range of student factors. More research is needed, particularly at postgraduate level, to better understand the key effects of various factors on student outcomes.

Underpinned by Astin's input-environment-outcome conceptual model for assessment, this paper uses student data ($n > 6,000$) over recent years from a single UK higher education institution and multilevel ordinal logistic regression to model key influences on the likelihood of particular postgraduate taught (PGT) outcomes (in three categories: pass/merit/distinction). Predictors include undergraduate attainment, and a range of candidate characteristics such as student ethnicity, sex, age, department, undergraduate performance.

We find that there is a strong relationship between undergraduate and postgraduate outcomes, and that department and student ethnicity are relatively small but important factors influencing the likelihood of particular PGT outcomes. The key finding is that important gaps in PGT outcomes remain when a range of factors are included in the analysis – conceptually in both 'inputs' and 'environment' as per Astin. Institutions need to carefully take account of these patterns of attainment when developing policy to enhance equality in PGT education. This research can help inform more focused policies aimed at closing attainment 'gaps' over time.

KEYWORDS

Postgraduate outcomes; attainment gaps; disparities; ethnicity; sex

Introduction – awarding gaps and policy in higher education

Educational disparities in the UK's Higher Education (HE) system have long been a source of concern (Broecke & Nicholls, 2006; Connor et al., 1996; Naylor & Smith, 2004; Owen, 2000; Richardson, 2008, 2015). These gaps in attainment outcomes, notably regarding student sex, ethnicity, prior educational background, and disability, raise concerns about fairness in HE outcomes and wider policy. Despite attempts to understand and mitigate these inequalities (Foliano et al., 2019), they remain an ongoing issue and a major concern for policymakers in the UK and beyond (Office for National Statistics, 2019).

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In order to ensure fair and equal access to education, institutions must seek to understand the factors driving attainment gaps between different student groups. Research into attainment gaps in HE focuses largely on undergraduate outcomes, and there is a relative paucity of literature investigating the extent to which inequalities in outcomes exist for postgraduate programmes. Given this, several organisations have advocated for more research focussed on postgraduate education (British Academy, 2012; Morgan, 2014; Whitty & Mullan, 2013).

There is a growing recognition across all stakeholders of the importance of ensuring that particular groups of students are not unfairly disadvantaged in their postgraduate studies and attainment outcomes. In part, this is because the link between postgraduate degrees, career prospects and life outcomes is increasingly recognised (Britton et al., 2020), as the latest Higher Education Statistics Agency (HESA) figures show 66% of postgraduates versus 56% of undergraduates were in employment six months after graduation (HESA, 2023).

UK HE institutions increasingly offer a diverse range of degrees, including taught master's and research doctorates. British-taught master's programmes have seen the most growth in students, with enrolments increasing by 51% between 2016 and 2021 (compared to a 13% increase in those sitting undergraduate degrees), and this trend is expected to continue. Despite the growing number of domestic and international students pursuing postgraduate study, the extent to which inequalities in outcomes exist for postgraduate programmes is rarely reported (Morgan, 2014; Wakeling & Kyriacou, 2010).

There is a need for an updated and expanded investigation into the data on postgraduate outcomes, to determine the extent to which the relationship between attainment and a range of student and other factors extend beyond that evidenced in undergraduate degrees. Informed by an extensive literature review that emphasises empirical studies but also discusses theoretical and conceptual framings, this paper uses student data over five recent years from a single higher education institution to carry out an empirical study modelling key influences on postgraduate taught (PGT) outcomes (pass/merit/distinction) – including, for example, undergraduate attainment and a range of candidate characteristics including student ethnicity, sex, and age, as well as measures of undergraduate institutional quality. Such statistical modelling can help reveal the independent effect of key characteristics on PGT outcomes and can also contribute to an evidence base for policy development aimed at reducing any unfair 'gaps' thereby identified. It can also provide a spur to greater conceptual understanding of how awarding 'gaps' might occur and how they might be best diminished over time.

Literature review - predictors of academic performance/awarding gaps

Conceptual framework

Astin's Input-Environment-Outcome (I-E-O) model (Astin & Antonio, 2012) suggests that student 'input' (i.e. student characteristics that they bring to the educational programme at the entry) and educational environment (i.e. anything students are exposed to during the educational programme) are essential in explaining student assessment outcomes. 'Input' includes demographics and prior academic experience, while 'environment' can include programmes, educational practices and policies (Astin & Antonio, 2012). The I-E-O model was originally implemented to investigate the effects of 'environment' on outcomes, with 'input' variables generally viewed as those to be statistically controlled for (Astin & Antonio,

2012). We use it in this study to provide a conceptual framework for considering a range of postgraduate students' factors (e.g. sex, ethnicity, prior attainment) as 'input', and others (postgraduate school, year of award) as 'environment', to understand and interpret the awarding 'gaps' evidenced between different student sub-groups. We return to the Astin model at various points in this work.

What follows are separate sub-sections on sex, ethnicity, age, socio-economic status, disability, and prior academic performance as these have emerged as key factors when reviewing the literature (these are all 'inputs' in Astin's terminology). Space considerations imply that this should not be regarded as a completely exhaustive review – a limitation we return to briefly in our discussion.

Sex

In the UK, women consistently attain 'good' undergraduate degrees at a rate approximately five percentage points higher than men, even when entry qualifications are taken into account (Higher Education Funding Council for England [HEFCE], 2018; Naylor & Smith, 2004). This difference has remained relatively stable, despite an overall rise in the proportion of good degrees awarded. Although there have been repeated calls to address male under-attainment in higher education (Hillman & Robinson, 2016; Vincent-Lancrin, 2008), female students remain more likely than males to receive upper second-class or first-class honours at undergraduate level (HESA, 2023). These outcomes often serve as a gateway to postgraduate study.

Research by the Organisation for Economic Co-operation and Development (OECD), cited by Hillman and Robinson (2016), found that boys devote less time to homework, exert less effort, and express less value for school compared to girls. These behaviours and beliefs, often associated with masculine peer cultures, may contribute to lower persistence and weaker academic outcomes. Meanwhile, girls and young women tend to report greater anxiety and lower self-efficacy in subjects such as mathematics and science (Lundberg, 2020), which can affect both participation and performance.

Nevertheless, some studies report that while women outperform men in general classifications, there is no significant difference between the sexes in the award of first-class degrees (HEFCE, 2018). This suggests that the gender attainment gap may narrow or disappear at the highest levels of academic achievement. It is also important to recognise institutional variation. At the University of Oxford, for example, men have been more likely than women to attain first-class honours, with larger disparities in some disciplines such as physics (Ahlburg & McCall, 2021; The Oxford Student, 2019).

These achievement gaps are particularly relevant given their implications for future life outcomes, including earnings. A recent report found that men with a first-class degree earn 7% more than those with an upper second, while women with the same distinction earn 3.5% more (Britton et al., 2022). Both sexes benefit from higher classifications, and the financial consequences appear greater for men.

Ethnicity

Ethnicity is a key predictor of attainment gaps in UK higher education, with consistent evidence showing that students from BAME (Black, Asian and Minority Ethnic) backgrounds are less likely to achieve 'good' degrees than their White peers (Richardson,

2015). Even after accounting for factors such as age, socio-economic background, and prior attainment, large-scale studies show that ethnicity remains strongly linked to degree outcomes (Broecke & Nicholls, 2006; Smith, 2016). According to the UK Office for Students [OfS] (2022), higher percentages of White students achieve top degrees - on average around 18 percentage points higher than Black students and 10 percentage points higher than all students from minority ethnic backgrounds.

While differences in financial, social, and cultural capital explain some variation in attainment, they do not fully account for ethnic disparities (Massey, 2006). Psychological factors such as stereotype threat, where awareness of negative stereotypes impairs performance, offer stronger explanatory insight (Claridge et al., 2018; Owens & Massey, 2011). Qualitative studies also point to the everyday realities of discrimination, including stereotyping by staff, microaggressions, and weak institutional belonging (Claridge et al., 2018; Nightingale et al., 2022; Rana et al., 2022; Wong et al., 2021). Many minority students describe having to work harder to prove themselves amid assumptions about race and background, and report a lack of cultural sensitivity or inclusion in academic and peer networks (Claridge et al., 2018; Cotton et al., 2016; Quyoum et al., 2022). The consistency of these findings suggests that similar ethnic disparities are likely present in other postgraduate disciplines.

Postgraduate focused research on this topic is limited and often concentrated in medicine. Disparities between minority and non-minority students across medical schools, assessment formats, and qualification levels are persistently reported (Woolf, 2020; Woolf et al., 2011). These gaps remain even after controlling for sex, age, and previous performance (Tiffin & Paton, 2021), and are not accounted for by differences in clinical knowledge. Crucially, the impact extends beyond education into employment and career progression (Woolf, 2020).

Age

In the UK, students are typically considered mature if they begin their undergraduate studies over the age of 21, or postgraduate studies over the age of 25. Cross-sectional research indicates that intellectual functioning peaks around age 18 before declining gradually (Rugg, 2016; Verhaeghen & Salthouse, 1997). Some studies suggest a non-linear relationship between age and academic outcomes, with performance peaks at approximately 18–19 and again at 26–30, followed by a decline in later years (Bourner & Hamed, 1987; Woodley, 1984).

However, cognitive ageing alone cannot fully explain attainment patterns by age. Mature students are often balancing education with caring responsibilities, employment, and financial pressures, which can limit their time and energy for academic work. This group is more likely to come from lower socio-economic backgrounds and to report being ‘time poor’, as they juggle responsibilities (Post, 2021). These constraints may reduce opportunities for engagement and contribute to lower performance, particularly at postgraduate level, where demands are high.

Some evidence challenges the notion that older students are disadvantaged. Research on self-regulated learning suggests that mature students may develop more effective study habits, drawing on life experience and motivation (Stoten, 2015). Newman-Ford et al. (2009) found that age did not significantly predict performance and that older students often achieved a higher proportion of good marks. However, their findings also indicate that students aged 26–30 may experience a decline in performance, likely due to growing responsibilities outside of their academic studies.

In the context of postgraduate education, where most students are over 25 (HESA, 2025), understanding age effects becomes particularly relevant. Research in this area is concentrated in medical education. For instance, one report found that candidates under 29 were more likely to pass surgical exams on the first attempt than those aged 29 and above (Ellis, Brennan, et al., 2022). Similarly, another report found a negative association between age and exam performance in psychiatry (Omigbodun & Omigbodun, 2003). These findings suggest that further research is needed to examine how age shapes attainment in postgraduate contexts beyond medicine.

Socio-economic status

It is well-known that there are large attainment gaps by socio-economic status (SES) at 16 and beyond in the UK (Crawford & Greaves, 2015; Strand, 2021). Using data from the UK, Mateos-González and Wakeling (2022) show that economically advantaged students are more likely to attain 'good' degrees and access to postgraduate education. This range of evidence implies that there are important selection effects by SES into further and higher education in the UK, but largely unknown direct effects of SES on attainment in master's level education.

Disability

Currently, around 21% of applicants to UK undergraduate programmes declare a disability (UCAS, 2023). The majority of these are specific learning differences such as dyslexia or dyspraxia. Reports also indicate a sharp increase in declarations of mental health conditions, which have risen by 450% over the past decade (UCAS, 2021).

Recent evidence shows growing recognition of the need to better support disabled students in higher education. A report by the Office for Students found that graduating from university significantly reduces the employment gap between disabled and non-disabled individuals (OfS, 2020). Nevertheless, concerns remain, as disabled students are less likely to complete their degrees, progress to further study, or enter high-skilled employment. In terms of attainment, disabled undergraduates are also less likely to receive 'good' degree classifications than their non-disabled peers (OfS, 2020).

Although some studies link declared disabilities to slightly lower attainment, these effects often become relatively small once other factors like age and prior achievement are also considered (Richardson, 2001, 2009; Richardson et al., 2002). Nonetheless, research highlights that many disabled students face systemic barriers that can hinder their educational experiences and progression. The social model of disability (Oliver, 2013) frames disability as a product of inaccessible teaching, rigid assessments, limited support, and negative attitudes (Chalise, 2024). Despite improvements in access to HE, disabled students continue to report lower satisfaction, weaker support, and higher intentions of dropping out or not progressing to postgraduate study (OfS, 2020; Zhou, 2023). These challenges often persist into postgraduate education.

Most research on disability and attainment focuses on undergraduate students, though there is emerging work at postgraduate level, particularly in medical education. A large observational study using UK medical education data found that students with declared specific learning difficulties were as likely as their peers to earn a primary medical qualification (Murphy et al., 2022). Similarly, Ellis, Cleland, et al. (2022) found no difference in success

rates between disabled and non-disabled candidates taking postgraduate surgical exams. Further research is needed to understand the barriers and facilitators that shape the postgraduate experience for disabled students, particularly outside of medicine.

Prior academic performance

Prior academic performance is widely recognised as one of the strongest predictors of future educational success (Smith, 2016). Outcomes such as a first-class or upper second-class degree are closely linked to prior entry qualifications, with students who enter university with higher attainment more likely to achieve strong degree results (Jones et al., 2017). McCarey et al. (2007) found a clear correlation between strong entry qualifications and academic success at university. This supports the broader view that students who perform well in secondary education often sustain high achievement throughout their studies (McKenzie & Schweitzer, 2001; Naylor & Smith, 2004; Smith & Naylor, 2001, 2005). It is reasonable to expect that this trend would continue into postgraduate education, particularly given the role of undergraduate outcomes in admissions decisions. However, the nature of this relationship is not yet fully understood.

While some studies suggest that undergraduate performance is only weakly predictive of postgraduate success, others report stronger associations. For instance, a study of first-year medical residents at the University of Calgary found limited correlation between undergraduate grades and performance during residency based on standard (Pearson) correlation analysis (Woloschuk et al., 2010). In contrast, research on computer science undergraduates at ETH Zurich, which employed random forest regression and also included predictors such as gender and age, found that a considerable share of the variation in postgraduate outcomes could be attributed to undergraduate grades (Zimmermann et al., 2011).

These differing findings, based on discipline-specific samples and using varied methods, suggest that the strength of the relationship between undergraduate and postgraduate performance is likely to vary by subject area, but might also reflect these different methodological choices to an extent. In this study, we intend to examine this relationship across a wide range of disciplines, and with important 'input' and 'environment' characteristics also considered.

The present study

Despite efforts to address educational disparities in UK HE (HEFCE, 2018), the evidence suggests that gaps in student outcomes persist, particularly when it comes to sex, ethnicity, disability, and prior educational background. Although some research has investigated the replication or otherwise of inequalities at the undergraduate level into the postgraduate level, particularly in medical education, the scarcity of published research across a wider range of disciplines limits our understanding.

Analysis of influences on postgraduate student outcomes is therefore urgently required to provide greater insight into rapidly growing higher education enrolment (Hewitt, 2020). Postgraduate students deserve a similar focus on their programmes of study and their educational experience as is currently afforded to undergraduates. Increased knowledge and transparency will help inform policy and practice and contribute to improving all students' likelihood of success in postgraduate studies. The extant literature highlights

the need for targeted research to understand the specific influences of ethnicity, undergraduate performance, and institutional factors on success in master's programmes and how these and other factors may collectively affect taught postgraduate outcomes. To contribute to the evidence base in this area, this paper uses student-level data over five recent years from a single higher education institution to statistically model key influences on postgraduate taught (PGT) outcomes. Underpinned by Astin's I-E-O model (Astin & Antonio, 2012), we include undergraduate attainment and a range of candidate characteristics such as student ethnicity and sex as 'input' and consider the proxies for the general education 'environment' (e.g. postgraduate school/department and year of award) in our analysis. Our intention is to answer the following research question:

What are the important independent influences on PGT outcomes?

The paper continues with an overview of the methodologies employed, the findings of the analysis, and a discussion of the key issues that arise in the contribution to the literature that this work represents.

We signpost here that this study concerns actual student final outcomes, and we have no data on access to, participation in or retention on master's programmes – this is an important limitation of this work, and one we return to in the later *Discussion* section where we also consider other study limitations.

Methodology

Sample

Our sample comes from the University of Leeds, a large public research-intensive institution based in the north of England with around 40,000 students of whom around 12,000 are on postgraduate taught (PGT) master's degree programmes. The data consist of student-level postgraduate (PGT) outcomes awarded over the five-year period 2017/18 to 2021/22 across 43 different schools. These outcomes are recorded in the data in three levels (Pass/Merit/Distinction,¹ with original raw marks at programme level unavailable). The data only include candidates who remained on the programme and do not include those who left before final assessments.

A range of student characteristics (i.e. 'inputs' in Astin's I-E-O model) were available in the data for inclusion in the modelling. These include student age (in four categories), sex (female/male), ethnicity in six categories, disability status (disabled or not), and undergraduate award (in four categories).

Also included were proxy measures of quality of each student's undergraduate institution (prior academic experience as 'input') – institution research grant and contracts ranking,² Times university guide to teaching and research rank from 2022,³ and undergraduate institutional classification as Russell Group or not.⁴ As these three measures are highly correlated with each other (Spearman's rho values range between 0.79 and 0.88, $p < 0.001$), principal component factor analysis was conducted on these to generate a composite variable (*UG Institution Quality*) to be included in modelling – this has a mean 0 and standard deviation 1, with higher values corresponding to lower measures of quality/ranking. We have included this measure to investigate the extent to which there is an impact of undergraduate institution on PGT outcomes above and beyond the

overall (first) degree outcome itself – based on the known differences in assessment practices and standards in undergraduate UK higher education (Medland, 2016).

Study mode (full- or part-time) was treated as ‘self-produced environmental experience’ (Astin & Antonio, 2012) and therefore included in modelling. Considering that education practices and assessment and awarding policies to some extent might have been modified over the years 2017/18 to 2021/22, especially during the Covid-19 pandemic (Chan, 2023), year of awarding was also included as an ‘environment’ variable.

Only data from UK students were included, given that we wanted to include comparable undergraduate award and ethnicity data as key factors in the study, and these are largely missing in our data or not sufficiently comparable for non-UK students. There are also a range of specific internal⁵ and external⁶ policy foci on UK students.

There were 8,903 UK students in total in the data extract, but 2,756 (31%) of them had missing data⁷ and these cases were excluded from analysis. This leaves 6,147 students who had complete information of all predictor variables in the final dataset and our analysis focuses on this latter group. Logistic regression analysis of patterns of missingness indicates that for all undergraduate institution-related predictors the odds of missingness is significantly negatively associated with PGT outcomes (i.e. those with lower PGT outcomes were more likely to have missing data). This implies that excluding these cases is a potential source of bias in the results, and we will return to this limitation in the *Discussion*.

The 43 postgraduate schools (i.e. university departments) in the data have a median of 105 students in each (minimum 1, maximum 875). For more details of the sample distributions and the precise make-up of all variables see [Table 1](#) in the *Findings* section.

Methods of analysis

As PGT students are nested in schools, those in the same school may be more homogenous than those in other schools. Taking this school (‘environment’) effect into account, we investigate multiple influences on PGT outcomes in a multivariate analysis, using multilevel ordinal logistic regression modelling carried using Stata package *meologit* in Stata 18 (Liu, 2016) with PGT outcome in three ordinal categories as the dependent variable. The student PGT school is treated as a random (intercept) effect in the modelling (referred to from now on as *School*).

In the analysis, we treat almost all student factors as fixed effects (i.e. as categorical variables with a set of discrete levels). The estimates for each level of each predictor can then be interpreted as independent of all other effects (i.e. the effect having controlled for all other factors in the model). We include only main effects – there are not enough data, nor is there clear specific justification in the literature, to include interaction effects. Only *UG Institution Quality* is treated as a continuous variable.

We have four results tables:

- (1) A descriptive summary of predictor variables by PGT outcome ([Table 1](#))
- (2) A summary of null (i.e. no predictors) and full model comparisons ([Table 2](#))
- (3) The overall odds ratio for the impact on PGT outcomes of each level of each categorical predictor in the full model ([Table 3](#))

- (4) The marginal probabilities for each level of PGT outcome estimated when holding the statistically significant predictors at their typical values (i.e. the mean for the continuous variable, and across the distribution of levels for a categorical variable) (Table 4)

Ethical issues

The dataset was fully anonymised prior to being made available for analysis, and ethical approval was granted by the University of Leeds ethics committee (reference BESS 2023–0699).

Findings

The distribution of all predictor variables, and their association with PGT outcome, is shown in Table 1. For the categorical variables, the percentages in brackets are of the whole sample.

The total rows indicate that only a small fraction of all PGT outcomes correspond to a pass degree (9%), with the remainder split approximately evenly between merit (48%) and distinction (43%).

Modelling results

Overall model statistics

A null model analysis (i.e. with no predictors, only including *School* as a random effect) indicates that between-school variance is statistically significant ($\chi^2_{(1)} = 306.66, p < 0.001$). This tells us that multilevel modelling is preferred compared with a single-level ordinal logistic regression analysis that would ignore clustering by *School*.

Table 2 then presents the overall results of the multilevel modelling with a comparison of the null (i.e. with only *School* as a random effect) and full model (all random and fixed effect predictors). The intraclass correlation coefficient (ICC) in the null model is 0.08, suggesting that 8% of the total variance in PGT award outcomes can be explained by schools.

Compared with the null model, the full model with the addition of all fixed effect predictors has smaller values of log likelihood, Akaike's information criterion (AIC), and Bayesian information criterion (BIC), which also suggests that the full model is favoured. The likelihood ratio test result also suggests the full model fits the data better than the null model ($\chi^2_{(19)} = 1003.42, p < 0.001$).

The marginal R^2 and conditional R^2 (Nakagawa et al., 2017) of the full model are 0.18 and 0.26, indicating that fixed effects approximately explain 18% of the variance in the outcome variable, and that including the random effect *School* increases the explained variance to 26%.

The ICC in the full model at 10% suggests that even having accounted for a range of student factors, *School* effects remain important in explaining PGT outcomes.

Fixed effects and marginal probabilities

For the full model (with all predictors included), Table 3 shows the estimates for each level of each categorical predictor and for the composite continuous variable *UG Institution Quality*.

Table 1. Descriptive distribution of predictor variables by PGT outcome.

		PGT Degree Class			
Predictor		Pass (<i>N</i> (%))	Pass with Merit (<i>N</i> (%))	Pass with Distinction (<i>N</i> (%))	Total (<i>N</i> (%))
Year of Award	2017/18	112 (1.82)	520 (8.46)	364 (5.92)	996 (16.2)
	2018/19	136 (2.21)	612 (9.96)	463 (7.53)	1211 (19.7)
	2019/20	71 (1.16)	481 (7.82)	528 (8.59)	1080 (17.57)
	2020/21	102 (1.66)	596 (9.7)	650 (10.57)	1348 (21.93)
	2021/22	129 (2.1)	757 (12.31)	626 (10.18)	1512 (24.6)
Age group	Under 25	342 (5.56)	2127 (34.6)	1940 (31.56)	4409 (71.73)
	25–29	91 (1.48)	418 (6.8)	366 (5.95)	875 (14.23)
	30–39	62 (1.01)	257 (4.18)	205 (3.33)	524 (8.52)
	40 and over	55 (0.89)	164 (2.67)	120 (1.95)	339 (5.51)
Gender	Female	301 (4.9)	1681 (27.35)	1540 (25.05)	3522 (57.3)
	Male	249 (4.05)	1285 (20.9)	1091 (17.75)	2625 (42.7)
Ethnicity	White	355 (5.78)	2304 (37.48)	2201 (35.81)	4860 (79.06)
	Asian	99 (1.61)	267 (4.34)	146 (2.38)	512 (8.33)
	Black	36 (0.59)	104 (1.69)	38 (0.62)	178 (2.9)
	Mixed	22 (0.36)	117 (1.9)	102 (1.66)	241 (3.92)
	Other	7 (0.11)	37 (0.6)	24 (0.39)	68 (1.11)
Mode	Unknown	31 (0.5)	137 (2.23)	120 (1.95)	288 (4.69)
	Full-time	339 (5.51)	2184 (35.53)	2080 (33.84)	4603 (74.88)
	Part-time	211 (3.43)	782 (12.72)	551 (8.96)	1544 (25.12)
Disability	No known disability	469 (7.63)	2513 (40.88)	2271 (36.94)	5253 (85.46)
	Disabled	81 (1.32)	453 (7.37)	360 (5.86)	894 (14.54)
Previous UG Award	Third/Ordinary/Pass	39 (0.63)	135 (2.2)	87 (1.42)	261 (4.25)
	2:2	110 (1.79)	221 (3.6)	90 (1.46)	421 (6.85)
	2:1	325 (5.29)	1814 (29.51)	1236 (20.11)	3375 (54.9)
	First	76 (1.24)	796 (12.95)	1218 (19.81)	2090 (34)
	Total	550 (8.95)	2966 (48.25)	2631 (42.8)	6147 (100)
		Pass (Mean (<i>SD</i>))	Pass with Merit (Mean (<i>SD</i>))	Pass with Distinction (Mean (<i>SD</i>))	Total (Mean (<i>SD</i>))
UG Institution Quality	(Higher values indicate lower quality/ranking)	0.48 (1.01)	0.12 (1.02)	–0.23 (0.91)	0(1)

Table 2. Comparison between the null and full models.

Model	N	Between-school variance	ICC	Log likelihood	df	AIC	BIC
Null model	6,147	0.28	0.08	−5568.4	3	11,142.8	11,163.0
Full model	6,147	0.38	0.10	−5066.7	22	10,177.4	10,325.3

We see that most of these effects on PGT outcomes are statistically significant – rows are highlighted for $p < 0.05$.

In terms of interpreting the results of Table 3, we see that, for example, the odds of having a higher category of PGT award in 2019/20 and 2020/21 are statistically greater than the reference year 2017/18. By contrast, there is no significant difference in the model estimates of the corresponding odds ratios for the years 2018/19 and 2021/22 relative to 2017/18. In other words, all other things being equal, the model is suggesting that patterns of grading were elevated in 2019/20 and 2020/21 compared to 2017/18 (but were not in 2018/19 and 2021/22).

Other statistically significant differences in PGT outcomes are seen in Table 3 for age, ethnicity, undergraduate award and UG institutional quality. We shall describe all findings in detail shortly but first present our perhaps most accessible final set of results in Table 4. This displays the model-based estimate of the marginal probability of being in each level of the PGT outcome (pass/merit/distinction) for each category of each predictor (at average values of other predictors). For brevity, we include in Table 4 only the statistically significant variables from Table 3.

We describe the key findings across Tables 3 and 4:

Table 3. Estimates for fixed effects in the full model.

Predictor		Odds ratio	Std. error	z	p	[95% conf. interval for odds ratio]	
Year of Award (reference = 2017/18)	2018/19	1.15	0.10	1.58	0.114	0.97	1.36
	2019/20	1.90	0.17	7.11	<0.001	1.59	2.28
	2020/21	1.68	0.15	6.04	<0.001	1.42	2.00
	2021/22	1.07	0.09	0.84	0.399	0.91	1.27
Age group (reference = Under 25)	25–29	1.63	0.14	5.76	<0.001	1.38	1.93
	30–39	1.63	0.18	4.35	<0.001	1.31	2.03
	40 and Over	1.49	0.20	2.98	<0.01	1.14	1.93
Gender (reference = Female)	Male	0.90	0.05	−1.91	0.057	0.80	1.00
Ethnicity (reference = White)	Asian	0.49	0.05	−7.3	<0.001	0.40	0.59
	Black	0.39	0.06	−6.02	<0.001	0.28	0.53
	Mixed	0.74	0.10	−2.22	<0.05	0.57	0.97
	Other	0.58	0.14	−2.2	<0.05	0.36	0.94
	Unknown	0.81	0.10	−1.65	0.099	0.64	1.04
Mode (reference = Full-time)	Part-time	0.84	0.08	−1.82	0.069	0.70	1.01
Disability (reference = No known disability)	Disabled	0.91	0.07	−1.24	0.214	0.79	1.05
Previous UG Award (reference = Third/Ordinary pass)	2:2	0.58	0.10	−3.05	<0.01	0.41	0.83
	2:1	1.44	0.22	2.38	<0.05	1.07	1.93
	First	4.12	0.65	9.01	<0.001	3.03	5.61
UG Institution Quality		0.58	0.02	−19.05	<0.001	0.55	0.61
Intercept		0.38	0.10			0.22	0.65

Table 4. Model estimates of marginal probabilities.

Predictor		Marginal probability		
		Pass	Pass with Merit	Pass with Distinction
Year of Award	2017/18	0.09	0.54	0.37
	2018/19	0.08	0.52	0.40
	2019/20	0.05	0.43	0.52
	2020/21	0.05	0.46	0.49
	2021/22	0.08	0.53	0.39
Age group	Under 25	0.08	0.52	0.40
	25–29	0.05	0.44	0.51
	30–39	0.05	0.44	0.51
	40 and Over	0.05	0.45	0.49
Ethnicity	White	0.06	0.48	0.46
	Asian	0.11	0.58	0.30
	Black	0.14	0.60	0.26
	Mixed	0.08	0.53	0.39
	Other	0.10	0.56	0.34
	Unknown	0.07	0.52	0.41
Previous UG Award	Third/Ordinary/Pass	0.12	0.59	0.30
	2:2	0.18	0.62	0.20
	2:1	0.09	0.54	0.37
	First	0.03	0.36	0.61
UG Institution ^a	–0.9	0.04	0.41	0.54
	0	0.07	0.50	0.43
	1	0.11	0.58	0.32
	1.3	0.12	0.59	0.28

Note: ^aThe values chosen here are illustrative and somewhat arbitrary.

- *Undergraduate award* – for students having a First class or Upper-second class degree, their odds of being in a higher PGT attainment level are 4.1 times and 1.4 times as great respectively as the odds for those with only a Third/Pass degree. The probabilities for these groups to achieve ‘Pass with Distinction’ are 61% and 37% respectively when other predictors are controlled for, as compared to 30% for those with a Third/Pass degree.
- *Ethnicity* – compared to White students, the odds of having a higher level of PGT outcome were less than half for students from Black (odds ratio (OR) = 0.39) or Asian (OR = 0.49) ethnic groups. Black students had the highest probability (14%) of being awarded a ‘Pass’ and had the lowest probability of achieving ‘Pass with Distinction’ (26%) compared to all the other ethnic groups.
- *Year of award* – the middle years of the study (2019/20 and 2020/21) show higher odds of being in a higher level of PGT outcomes compared to the baseline year (2017/18) (OR = 1.90 and OR = 1.68 respectively). The probabilities of being awarded ‘Pass with Distinction’ for students who graduated in the year 2019/20 and 2020/21 are 52% and 49% respectively, which are much higher than those in other years (37% to 40%).
- *Age* – all older age groups had higher odds of achieving higher level of PGT outcomes (1.6, 1.6, and 1.5 times as great respectively as the odds for Under 25s). Amongst these older age groups, the probabilities of obtaining the highest PGT outcome are quite similar (51%, 51%, and 49% respectively).
- *Measures of undergraduate research and teaching quality* – there is some evidence that students whose undergraduate institutions were ranked more highly on

research/teaching quality outscored those from lower ranked institutions – for one unit higher in undergraduate institution ranking (i.e. 1 standard deviation), the odds of being in a higher award level increase by a factor of 1.72, when holding all other variables constant.

- There are non-significant effects on PGT outcomes for *Sex*, *Mode of study* and *Disability status*.

By the design of the statistical model, all these effects are interpreted as independent of all other effects so particular intersectional differences (for example, ethnicity by undergraduate award) could be larger than the single effects shown in [Tables 3](#) and [4](#) for some sub-groups of students.

Discussion

In statistically modelling PGT outcomes, this study provides evidence around the key influences on attainment at this level of higher education in the UK and for UK students. We find that whilst there are a number of attainment ‘gaps’ identified for particular sub-groups, the overall model fit statistics imply that the *School* effects remain, having controlled for other factors (ICC for full model = 0.10, [Table 2](#)). We might consider *School* as a crude proxy for discipline/subject and/or the wider ‘environment’, and our results suggest there are different attainment profiles across these that remain even when all other factors are accounted for in the analysis. However, the extent to which such differences are due to variation in teaching/learning/selection practices across master’s programmes, or perhaps to differing standards and policies when it comes to awarding outcomes, we cannot say. The difficulties of meaningfully comparing academic performance across different disciplines remains an ongoing methodological challenge.

Our model fit statistics (i.e. variance explained of the order of 25%) suggest that the variables we have been able to include do not explain or determine PGT outcomes in any strongly predictive way. In other words, at the individual level there are other, perhaps more personal, affective, social, environmental, or difficult-to-measure factors (both ‘inputs’ and ‘environment’ in Astin and Antonio’s [2012] parlance), that influence how well students might perform in their taught master’s programmes (Shah & Ahluwalia, 2019). In policy terms, this suggests that institutions cannot take a blanket approach when supporting their students through their postgraduate studies but need to take a more individual approach to pastoral and educational support issues wherever possible.

Pursuing postgraduate education is often regarded as a substantial investment in prospects, as it comes with a significant financial risk for students. With the average cost of a master’s degree in the UK costing around £11,000 in fees per year (UCAS, 2014), and limited financial support available (Whitty & Mullan, 2013), undertaking a postgraduate master’s degree can be discouraging for many individuals and sub-groups, particularly if attainment outcomes are uncertain due to persistent awarding gaps. Furthermore, the implications of the attainment gap for students extend into the labour market, where the attainment of a ‘good’ undergraduate degree (typically being first-class or upper second-class honours) carries increasing significance (Broecke & Nicholls, 2006; Feng & Graetz, 2017; Naylor & Smith, 2004; Smith, 2016).

Our work has confirmed previous findings concerning lower attainment for certain sub-groups, particularly for certain non-white ethnic groups such as Black master's students (for a review, see Richardson, 2015). Given that the effects identified are independent of the other factors included in the analysis – for example, undergraduate attainment, PGT school and so on – this remains a cause for concern for all interested in promoting equity in higher education practices. Despite the methodological challenges that there are with arguably problematic groupings of likely non-homogeneous ethnic subgroups, the findings undoubtedly raise important policy concerns that need further research to fully understand. It seems likely that personal experiences during studies and other additional challenges that particular sub-groups might face during and prior to study, can result in lower PGT attainment. The extent to which 'ethnic gaps' might be reducing over time, as a result of particular policy interventions (Bryant et al., 2023; Cairney et al., 2022), needs ongoing longitudinal tracking to measure.

When it comes to undergraduate outcomes and their influence on PGT outcomes, our work confirms links between these, particularly for those with a First-class degree – who clearly outperform those with lower ranked undergraduate outcomes on average. This aligns with previous findings which highlight the significant association between prior attainment and academic performance (Jones et al., 2017). However, the relationship between prior and current attainment is quite nuanced in our data, and the relationship is not as strong and consistent as one might have perhaps expected. This suggests that across the sample, students who begin their master's studies with relatively weak undergraduate outcomes can still expect to progress to a final master's level not that far below those who come in with stronger undergraduate attainment.

The Year of study results, covering the Covid-19 pandemic are perhaps, to an extent, anomalous due to the impact of changes to approaches to teaching that took place over the academic years 2020, 2021 and the subsequent move to more online teaching since then (Takács et al., 2023) – a clear change in 'environmental' factors as per Astin and Antonio's (2012) model. Further, there were adjustments of regulations on the degree awarding at this time, when UK universities (including Leeds) widely made amendments to codes of practice on assessment. For example, there was the adoption of 'no detriment' policy or adjustment of the boundaries for degree classification, and the relaxation of policies on extensions of coursework submission. All these regulatory changes were likely to bring higher degree classifications (Chan, 2023).

Our results for student age, where older groups tend to outperform the youngest group (under 25s), suggest that typically there is some benefit to studying at master's level at ages 25 and over – although the size of these effects is relatively small. Further, the diversification of master's programmes into older groups (Universities UK, 2019) is likely to increase a little the overall performance of the full cohort and be of benefit both to the individual students and to institutions as a whole.

There are a number of important 'null' findings in our work – for example, finding little difference in performance between disabled and non-disabled categories of students, and between those who study full- or part-time. In addition, the difference between males and females in how they perform at master's level on average is not statistically significant. Whilst there is no room for complacency in these findings, they do suggest that some previous policies (Bryant et al., 2023; Cairney et al., 2022) to overcome differences, or perceptions thereof, have had

some success, and that going forwards differential attainment policies could be better focussed elsewhere.

Study limitations and future research

This is a study in a single UK HE institution over a single five-year period. Ideally, the study should be repeated across a range of institutions, which would allow for differences across institutions to be teased out.

It is also important to note that the main analysis is value-added, taking into account attainment at undergraduate level. Given that there are known attainment gaps at this earlier level (Richardson et al., 2020), a ‘raw’ analysis would likely give different, possibly larger, effects on differential attainment for some sub-groups. There are, of course, arguments against a value-added approach when it comes to determining policy, since absolute PGT attainment is (obviously) very important – it matters most what PGT students actually ultimately achieve, rather than merely measuring the progress that they make from their undergraduate study. This reflects an ongoing debate in wider education policy – see for example the discussion around what should or should not be included in school value-added measures in England (Leckie & Goldstein, 2019). We would argue that a value-added analysis makes the most sense when informing policy within the master’s programmes themselves, but that a different analysis might be needed to inform wider policies (e.g. those at undergraduate level or when judging the efficacy of the higher education system as a whole).

The analysis of missingness in some of our key predictors – based on our conceptual framework of ‘input’ and ‘environment’ (Astin & Antonio, 2012) – was not random, but rather more likely in more lower achieving students. It is difficult to be sure in what directions any bias in our model estimates is likely to be, but ideally more complete data would be preferred in any future similar study. Beyond missing data, the substantial amount of the variance in the outcomes not explained suggests that future research should extend the exploration by including a wider range of ‘input’ (e.g. non-cognitive attributes) and ‘environmental’ (e.g. school- and institutional-level) variables and their interactions.

Our final limitation is to admit that this study is about differential attainment, with no data available here on participation or on retention in programmes. We cannot say anything at all about the equity of access, participation and retention *per se*, and differential participation by various sub-groups certainly requires further research. Our data include no measure of socio-economic status, and it is important for future studies to include this (Crawford & Greaves, 2015; Strand, 2021) – to help build more comprehensive understanding of the key influences on participation, retention and attainment at master’s level.

Notes

1. There were three failing UK students in the original dataset, and these have been removed.
2. <https://www.jisc.ac.uk/heidi-plus>
3. <https://www.thetimes.co.uk/uk-university-rankings>

4. https://en.wikipedia.org/wiki/Russell_Group
5. <https://www.leeds.ac.uk/student-success>
6. <https://www.officeforstudents.org.uk/for-students/equal-opportunities/help-improve-equality-of-opportunity/>
7. Gender (missing, $n = 26$), study mode ($n = 58$), undergraduate award ($n = 2222$), UG institution Russell Group membership ($n = 1047$), research grant and contracts ranking ($n = 1662$), or Times university guide to teaching and research rank ($n = 1740$).

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